

## CLAIMS

What is claimed is:

1. A method for replacing a solder ball, comprising:  
providing a workpiece having at least one solder ball bonded to an attachment site of the workpiece;  
extracting the at least one solder ball with a capillary tube to vacate the attachment site;  
retrieving at least another solder ball with the capillary tube;  
placing the at least another solder ball on the attachment site with the capillary tube; and  
bonding the at least another solder ball to the attachment site while holding the at least another solder ball in place with the capillary tube.
2. The method of claim 1, wherein extracting the at least one solder ball with the capillary tube comprises:  
de-bonding the at least one solder ball from the attachment site; and  
removing the at least one solder ball from the attachment site with the capillary tube by at least one of capillary action and a vacuum applied to the at least one solder ball through a bore of the capillary tube.
3. The method of claim 2, wherein de-bonding the at least one solder ball from the attachment site comprises applying heat to the at least one solder ball sufficiently to reduce the solder thereof to a molten state, and wherein removing the at least one solder ball from the attachment site comprises drawing a vacuum through the bore of the capillary tube to facilitate drawing the solder in a molten state thereinto.

4. The method of claim 2, wherein de-bonding the at least one solder ball from the attachment site comprises applying heat to the at least one solder ball to cause the at least one solder ball to release from the attachment site without completely melting, and wherein removing the at least one solder ball from the attachment site comprises drawing a vacuum through the bore of the capillary tube to lift the at least one solder ball with an end of the capillary tube.

5. The method of claim 2, wherein at least one of de-bonding the at least one solder ball from the attachment site and bonding the at least another solder ball to the attachment site comprises applying heat to the at least one solder ball or the at least another solder ball through the capillary tube.

6. The method of claim 5, wherein applying heat to the at least one solder ball or the at least another solder ball through the capillary tube comprises heating the capillary tube.

7. The method of claim 5, wherein applying heat to the at least one solder ball or the at least another solder ball through the capillary tube comprises directing a laser beam onto the at least one solder ball or the at least another solder ball through the bore of the capillary tube.

8. The method of claim 1, further comprising, aligning the capillary tube with the at least one solder ball or the attachment site by viewing the workpiece through a bore of the capillary tube.

9. The method of claim 8, wherein viewing the workpiece through the bore of the capillary tube comprises viewing the workpiece with one of a microscope and a camera.

10. The method of claim 1, wherein retrieving at least another solder ball with the capillary tube comprises drawing a vacuum through a bore of the capillary tube to lift the at least one solder ball with an end of the capillary tube.

11. The method of claim 10, wherein retrieving at least another solder ball with the capillary tube further comprises applying flux to the at least another solder ball by submerging a portion of the at least another solder ball into a flux reservoir with the capillary tube prior to placing the at least another solder ball on the attachment site with the capillary tube.

12. An apparatus for extracting and replacing individual solder balls on an attachment site of a workpiece, the apparatus comprising:

a support configured to receive a workpiece thereon;

a capillary tube including a distal end configured for contacting a solder ball; and

a structure configured for viewing the workpiece through a bore of the capillary tube.

13. The apparatus of claim 12, further including a vacuum source selectively operably coupled to the capillary tube for drawing a vacuum through the bore of the capillary tube.

14. The apparatus of claim 12, further comprising a heating device configured for applying heat to a solder ball through the capillary tube.

15. The apparatus of claim 14, wherein the heating device comprises a heater configured to heat the capillary tube.

16. The apparatus of claim 14, wherein the heating device comprises a laser configured to direct a laser beam through the bore of the capillary tube.

17. The apparatus of claim 12, wherein the structure configured for viewing the workpiece through a bore of the capillary tube comprises one of a microscope and a camera.

18. The apparatus of claim 12, wherein the capillary tube is mounted to a contact head configured for positioning the capillary tube over at least one of a solder ball disposal site, a solder ball reservoir, and a flux reservoir.

19. An apparatus for extracting and replacing an individual solder ball mounted on an attachment site of a workpiece, the apparatus comprising:

a support configured to receive a workpiece thereon;

a solder ball reservoir;

a contact head configured for positioning a capillary tube over the solder ball reservoir and the support, wherein the capillary tube includes a distal end configured to remove the individual solder ball from the attachment site of the workpiece and to replace the removed individual solder ball with another individual solder ball retrieved from the solder ball reservoir;

a heating device configured for applying heat to a solder ball through the capillary tube; and

a vacuum source selectively operably coupled to the capillary tube for drawing a vacuum through a bore of the capillary tube.

20. The apparatus of claim 19, wherein the heating device comprises a heater configured to heat the capillary tube.

21. The apparatus of claim 19, wherein the heating device comprises a laser configured to direct a laser beam through the bore of the capillary tube.

22. The apparatus of claim 19, further comprising a window in the contact head configured for viewing the workpiece through the bore of the capillary tube.

23. The apparatus of claim 22, further comprising at least one of a microscope and a camera configured for viewing the workpiece through the bore of the capillary tube.

24. The apparatus of claim 19, further comprising a solder ball disposal site, wherein the contact head is configured for positioning the capillary tube above the solder ball disposal site.

25. The apparatus of claim 19, further comprising a flux reservoir, wherein the contact head is configured for positioning the capillary tube above the flux reservoir.

26. A method for correcting a defective ball grid array on an electronic component workpiece, the method comprising:  
providing a workpiece having an array of solder balls secured thereto;  
identifying at least one defective solder ball associated with a corresponding attachment site of the array of solder balls on the workpiece; and  
extracting the at least one defective solder ball with a first capillary tube to vacate the corresponding attachment site by individually heating the at least one defective solder ball to a molten state and removing molten solder from the corresponding attachment site into the capillary tube by at least one of capillary action and a vacuum applied to the at least one solder ball through a bore of the capillary tube.

27. The method of claim 26, further comprising replacing the at least one defective solder ball with a nondefective solder ball placed on the vacated corresponding attachment site with a second capillary tube while maintaining other solder balls of the array of solder balls in undisturbed arrayed attachment to the workpiece.

28. The method of claim 27, wherein replacing the at least one defective solder ball with a nondefective solder ball further comprises lifting the nondefective solder ball using a vacuum provided through the second capillary tube, and locally heating the nondefective solder ball through the second capillary tube.

29. The method of claim 28, wherein heating the nondefective solder ball through the second capillary tube comprises heating the second capillary tube.

30. The method of claim 28, wherein heating the nondefective solder ball through the second capillary tube comprises directing a laser beam onto the nondefective solder ball through the bore of the second capillary tube.

31. The method of claim 27, wherein replacing the at least one defective solder ball with a nondefective solder ball further comprises applying flux to the nondefective solder ball by submerging a portion of the nondefective solder ball into a flux reservoir with the second capillary tube prior to placing the nondefective solder ball on the attachment site with the second capillary tube.

32. The method of claim 26, further comprising, aligning at least one of the first capillary tube and the second capillary tube with the attachment site by viewing the workpiece through a bore of the first capillary tube or the second capillary tube.

33. The method of claim 32, wherein viewing the workpiece through the bore of the first capillary tube or the second capillary tube comprises viewing the workpiece with one of a microscope and a camera.